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Claims

[c1] An acoustical barrier comprising a sheet of lightweight firm-flexible foam formed into a shape that is adapted to be mounted to a sound-transmitting substrate and having acoustic properties that meet both requisite sound absorption and sound transmission attenuation standards.

[c2] An acoustical barrier according to claim 1 wherein the sheet is molded into a complex shape.

[c3] An acoustical barrier according to claim 1 wherein the formed foam sheet has sufficient stiffness that it retains its shape during handling, shipment, and installation.

[c4] An acoustical barrier according to claim 3 wherein the acoustical barrier has an obverse surface and a reverse side, and wherein patterned recesses are formed in at least a portion of the reverse side, and wherein the patterned recesses are adapted to attenuate the transmission of sound from a sound-transmitting substrate against which the reverse side of the acoustical barrier is adapted to be placed.

[c5] An acoustical barrier according to claim 4 wherein the spacing and pattern of the recesses define a regular array.

[c6] An acoustical barrier according to claim 4 wherein the spacing and pattern of the recesses define an irregular array.

[c7] An acoustical barrier according to claims 4 wherein the spacing and pattern of the recesses define a regular array of spaced support columns that are adapted to contact the sound-transmitting substrate when the acoustical barrier is installed on the sound-transmitting substrate.

[c8] An acoustical barrier according to claim 4 wherein the thickness of the sheet varies to exhibit different acoustical properties at different portions of the sheet.

[c9] An acoustical barrier according to claim 3 wherein the thickness of the sheet varies to exhibit different acoustical properties at different portions of the sheet.

[c10] An acoustical barrier according to claim 1 wherein the foam has a density in the range of about 2 to 9 lb/cu ft.

[c11] An acoustical barrier according to claim 10 wherein the foam has a density of about 3.5 lb/cu ft.

[c12] An acoustical barrier according to claim 11 wherein the foam has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c13] An acoustical barrier according to claim 12 wherein the foam has a stiffness of at least 30 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c14] An acoustical barrier according to claim 10 wherein the foam has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c15] An acoustical barrier according to claim 1 wherein the foam has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c16] An acoustical barrier according to claim 1 and further comprising a thin impervious barrier layer overlying the foam layer.

[c17] An acoustical barrier according to claim 1 wherein the foam sheet when mounted to a steel substrate has sound transmission loss properties at least as great as that shown on curve 108 on the graph of FIG. 15.

[c18] An acoustical barrier according to claim 1 wherein the foam sheet when mounted on a steel substrate has sound transmission loss properties at least as great as that shown on the curve 72 on the graph of FIG. 7.

[c19] An acoustical barrier according to claim 1 wherein the foam has a porosity in the range of about 20 to 120 cells per inch.

[c20] A dash mat adapted to be installed against a firewall in a motor vehicle and within the passenger compartment of the vehicle comprising a single layer of molded lightweight firm-flexible foam that has a shape that generally conforms to the firewall of the vehicle and has acoustic transmission loss properties that are at least as great as those represented by curve 74 illustrated in Figure 7 hereof.

[c21] A dash mat according to claim 20 wherein the foam layer has selected areas that are configured to adjust the acoustical properties of the foam layer to match predetermined sound transmission requirements at selected

corresponding areas of the firewall.

[c22] A dash mat according to claim 21 wherein at least one of the selected areas has patterned recesses along a reverse side of the foam layer that attenuate transmission sounds through the foam layer.

[c23] A dash mat according to claim 22 wherein the spacing and pattern of the recesses define a regular array.

[c24] A dash mat according to claim 22 wherein the spacing and pattern of the recesses define an irregular array.

[c25] A dash mat according to claim 22 wherein at least one of the selected areas has an enlarged wall thickness to increase the sound absorption through the foam layer.

[c26] A dash mat according to claim 25 wherein the enlarged wall thickness at least partially surrounds an opening in the foam layer.

[c27] A dash mat according to claim 21 wherein the foam layer has sufficient stiffness to retain its shape during packaging, shipment, and installation.

[c28] A dash mat according to claim 20 wherein the foam layer has sufficient stiffness to retain its shape during packaging, shipment, and installation.

[c29] A dash mat according to claim 20 wherein the thickness of the foam layer varies to exhibit different acoustical properties at different portions of the dash mat.

[c30] A dash mat according to claim 20 wherein the foam layer has a density in the range of about 2 to 9 lb/cu ft.

[c31] A dash mat according to claim 30 wherein the foam layer has a density of about 3.5 lb/cu ft.

[c32] A dash mat according to claim 31 wherein the foam layer has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c33] A dash mat according to claim 30 wherein the foam layer has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c34] A dash mat according to claim 20 wherein the foam layer has a stiffness of at least 30 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c35] A dash mat according to claim 20 wherein the foam layer

has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c36] A dash mat according to claim 20 and further comprising a thin impervious barrier layer overlying the foam layer.

[c37] A dash mat according to claim 20 wherein the foam has porosity in the range of 20 to 120 pores per inch.

[c38] A dash mat according to claim 20 wherein the dash mat has acoustic transmission loss properties that are at least as great as those represented by curve 108 on the graph illustrated in Figure 15 hereof.

[c39] A vehicle having a firewall separating an engine compartment from a passenger compartment and having a dash mat according to claim 20 positioned within the passenger compartment against the firewall.

[c40] A method of attenuating sound through a firewall between a motor compartment and a cabin of a vehicle comprising the steps of;
mapping the sound transmission through the firewall between the engine compartment and the cabin as a function of a set of coordinates of a cabin surface of the firewall that faces the cabin;

selecting a firm-flexible foam that has both sound transmission and sound absorbing properties and that has structural integrity for handling, shipping and installation;

designing a layer of the selected firm-flexible foam in a shape that generally conforms to the cabin surface of the firewall and that has selected areas that are designed with configurations that have different acoustical properties that correspond to the mapped sound transmission properties as a function of the set of coordinates; and

molding the designed layer into a shape to generally conform to the cabin surface.

[c41] A method according to claim 40 and further comprising the step of installing the molded layer onto the firewall cabin surface of the vehicle.

[c42] A method according to claim 41 and further comprising the step of placing at least portions of the foam layer in full contact with the firewall cabin surface.

[c43] A method according to claim 40 wherein the designing step includes the step of designing at least one selected area with patterned recesses along a reverse side of the foam layer that attenuate transmission sounds through the foam layer.

[c44] A method according to claim 43 wherein the spacing and pattern of the recesses define a regular array.

[c45] A method according to claim 43 wherein the spacing and pattern of the recesses define an irregular array.

[c46] A method according to claim 43 wherein the designing step includes the step of designing at least one selected area with an enlarged wall thickness to increase the sound absorption through the foam layer.

[c47] A method according to claim 46 wherein the designing step includes the step of designing an opening in the foam layer and designing the enlarged wall thickness to at least partially surround the opening in the foam layer.

[c48] A method according to claim 40 wherein the designing step further comprising the designing the foam material, the thickness and shape of the foam layer so that the molded foam layer has sufficient stiffness to retain its shape during packaging, shipment, and installation.

[c49] A method according to claim 40 wherein the designing step includes the step of designing thickness variations in the foam layer to exhibit different acoustical properties at different portions of the dash mat corresponding to selected coordinates of the firewall cabin surface.

[c50] A method according to claim 40 wherein the foam layer has a density in the range of about 2 to 9 lb/cu ft.

[c51] A method according to claim 50 wherein the foam layer has a density of about 3.5 lb/cu ft.

[c52] A method according to claim 51 wherein the foam layer has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c53] A method according to claim 50 wherein the foam layer has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c54] A method according to claim 40 wherein the foam layer has a stiffness of at least 30 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifications.

[c55] A method according to claim 40 wherein the foam layer has a stiffness of between 30 and 300 pounds-force at a 25% indentation force deflection (IFD) using a 20" x 20" x 2" test sample pursuant to ASTM D3574-01 specifica-

tions.

[c56] A method according to claim 40 wherein the foam has porosity in the range of about 20 to 120 cells per inch.

[c57] A method according to claim 40 wherein the designing step includes designing the sound attenuation characteristics of the dash mat to have the acoustic transmission loss properties that are at least as great as curve 72 illustrated in Figure 7 hereof.

[c58] A method according to claim 40 wherein the designing step includes designing the sound attenuation characteristics of the dash mat to have the acoustic transmission loss properties that are at least as great as those represented by curve 74 illustrated in Figure 7 hereof.